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10 years of the IAU Efforts for Capitalizing the Ground-Based Astrometry

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Introduction

In 2000 a new IAU working group was founded (IAU GA, Manchester): Future Development of Ground-Based Astrometry (FDGBA). It was revised in 2003 during the IAU GA in Sydney. A new one replaced it in 2006 (IAU GA, Prague): Astrometry by Small Ground-Based Telescopes (ASGBT). It was renewed for other three years during the IAU GA in Rio de Janeiro.

The main aim of the working groups followed the Newsletter No. 1 of the IAU Commission 8, which says:

*The post-Hipparcos era has brought an element of uncertainty
as to the goals and future programs for all of ground-based astrometry*

The purpose of the WGs was “to update and maintain information on astrometric programmes and activities carried out by small telescopes, to diffuse news through these pages and e-mails, to facilitate the collaborations and to help for the coordination of the activities, when possible, in astrometry from ground-based telescopes”

1. Main objectives of the WGs

The main objectives of the WGs are:

- to identify programs that could be made on instruments that are either insufficiently used or working on projects that have no significant value for the present day astrometry.
- to make assessment of the whole situation including available instrumentation
- these instruments can be used as they are or with not too expensive modifications to teach students in astronomy how to use telescopes and, in the same time, to contribute in a significant way to astronomy.
- to update and maintain information on astrometric programmes and activities carried out by small telescopes,
- to facilitate the collaborations and to help for the coordination of the activities, when possible, in astrometry from ground-based telescopes.
- to teach the astrometric theory and practice to the next generation

The IAU WG ASGBT encourages astrometric measurements of positions for dynamics, fundamental astronomy or astrophysics, but also photometric observations of events for determination of size and shape, determination of the parameters of rotation can pay benefit from these instruments. This is possible e.g. thanks to observations of mutual events of the natural satellites, stellar occultations, mutual events of binary asteroids.

In this context, the encouraged cooperative projects are:

- Mutual phenomena of natural satellites (PHEMU - PHESAT) & binary asteroids
- Ground-based monitoring of astrometric binaries (GMAB)
- Dedicated astrometric network for the follow-up of Gaia (<http://www.rssd.esa.int/index.php?project=Gaia>)
- Astrometry of Radiosources optical counterparts for ICRF sources positioning
- Astrometry of natural satellites for their ephemerides
- Prediction of stellar occultations by specific objects, last minute astrometry (TNOs, Pluto...).

2. Limitations of the space astrometry missions

Astrometry by small ground-based telescope remains very useful in complement to space astrometry, since there are limitations of the space missions:

- **not flexible**: observations are either constrained by a scanning law (Gaia) or by overall programming (SIM or HST);
- **not designed for monitoring**: it is not possible to get long sequences of observation of a single body;
- **limited lifetime**: many astronomical features must be observed either indefinitely or at least a longer time;
- **often need preliminary data**: for instance, ephemerides or prediction of magnitudes of irregular variables
- **they are risky**.

3. Astrometric activities in complement to Gaia

Gaia will get benefit from a dedicated network for observations on alert and follow-up. Several observations can be made with small telescopes (e.g. determination of some asteroidal masses, the improvement of orbital models of neglected natural satellites.)

The work of the actual surveys and the advent of new large and fast surveys (e.g. Pan-Starrs, LSST) which store huge amounts of data reinforces the need to have follow-up observations, in particular for the study of the Near-Earth objects and the improvement of their orbits.

A Follow-up program for Gaia relates mainly to the astrometric aspect for solar system objects and intends to call for astrometrists to join a dedicated network to carry out these observations.

Context and problems

To ensure the maximum efficiency of the observations of detection by Gaia, it is needed to organize observations “on alert” to check and follow-up from the ground. Several means make it possible to organize these observations, in particular the diffusion of alarms by Internet on mailing lists (e.g. Minor Planet Mailing List) or the maintenance of an official page of targets. Whichever means used, even if they reach a great number of potential observers, would not ensure that good reactivity to alarms would occur. The constitution of a formalized network of dedicated observers appears necessary.

Constraints

It will be necessary to have a possibility of access to the telescopes “on alert” by a local observer. The process of observation of Gaia will allow that alarm to be given approximately 48 hours after the detection of an uncatalogued target. It will be necessary to have sensitive enough CCD cameras to detect objects as faint as magnitude 20, and pixel sizes corresponding to less than 1" on the sky. During the mission, if a preliminary catalogue from GAIA is available, smaller fields could be usable. It will be desirable that certain sites are of sufficient quality (high altitude) to reach observations with small solar elongation. Gaia will detect objects with a solar elongation down to 45° .

Conclusion

A follow-up program will be necessary to ensure the objects (of stellar, galactic and extra-galactic objects; objects of the solar system and numerous new objects) are not lost and to improve their ephemerides. Organizing a network requires time and different steps have to be done. The IAU WG *Astrometry by small ground based telescopes* encourage observers interested in this network, and particularly astrometric observers, to join the network now to help follow-up Gaia.

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